



ENSO Cycle: Recent Evolution, Current Status and Predictions

**Update prepared by
Climate Prediction Center / NCEP
2 July 2012**



Outline

- Overview
- Recent Evolution and Current Conditions
- Oceanic Niño Index (ONI) – **Revised March 2012**
- Pacific SST Outlook
- U.S. Seasonal Precipitation and Temperature Outlooks
- Summary



Summary

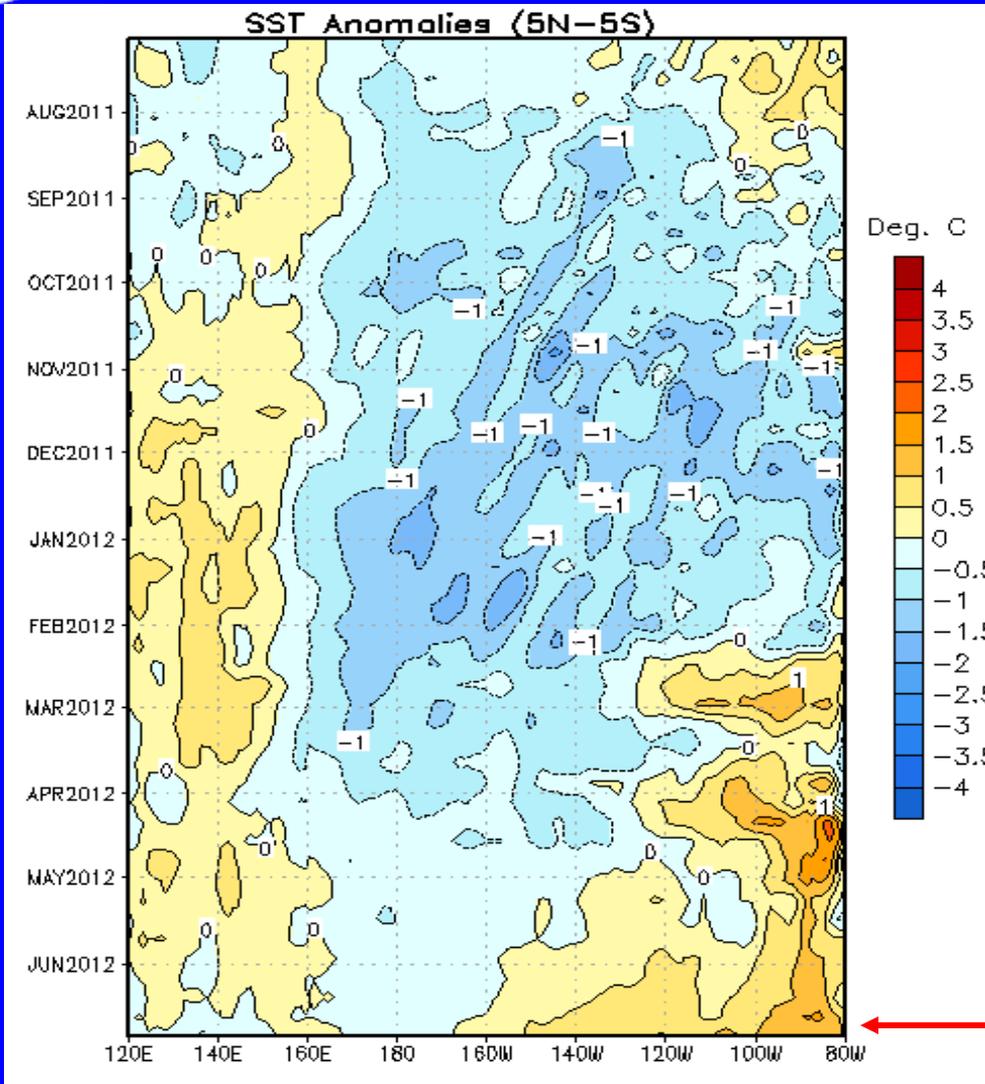
- **ENSO-neutral conditions continue.***
- **Equatorial sea surface temperatures (SST) are increasingly above average in the eastern Pacific Ocean.**
- **The atmospheric circulation over the tropical Pacific reflects cool-to-neutral ENSO conditions.**
- **There is a 50% chance that El Niño conditions will develop during the second half of 2012.***

* Note: These statements are updated once a month in association with the ENSO Diagnostics Discussion:
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory



Recent Evolution of Equatorial Pacific SST Departures (°C)

Time



Longitude

From September 2011- January 2012, below-average SSTs were evident across much of the equatorial Pacific Ocean.

Since February 2012, above-average SSTs have persisted in the far eastern Pacific, and have recently expanded westward.

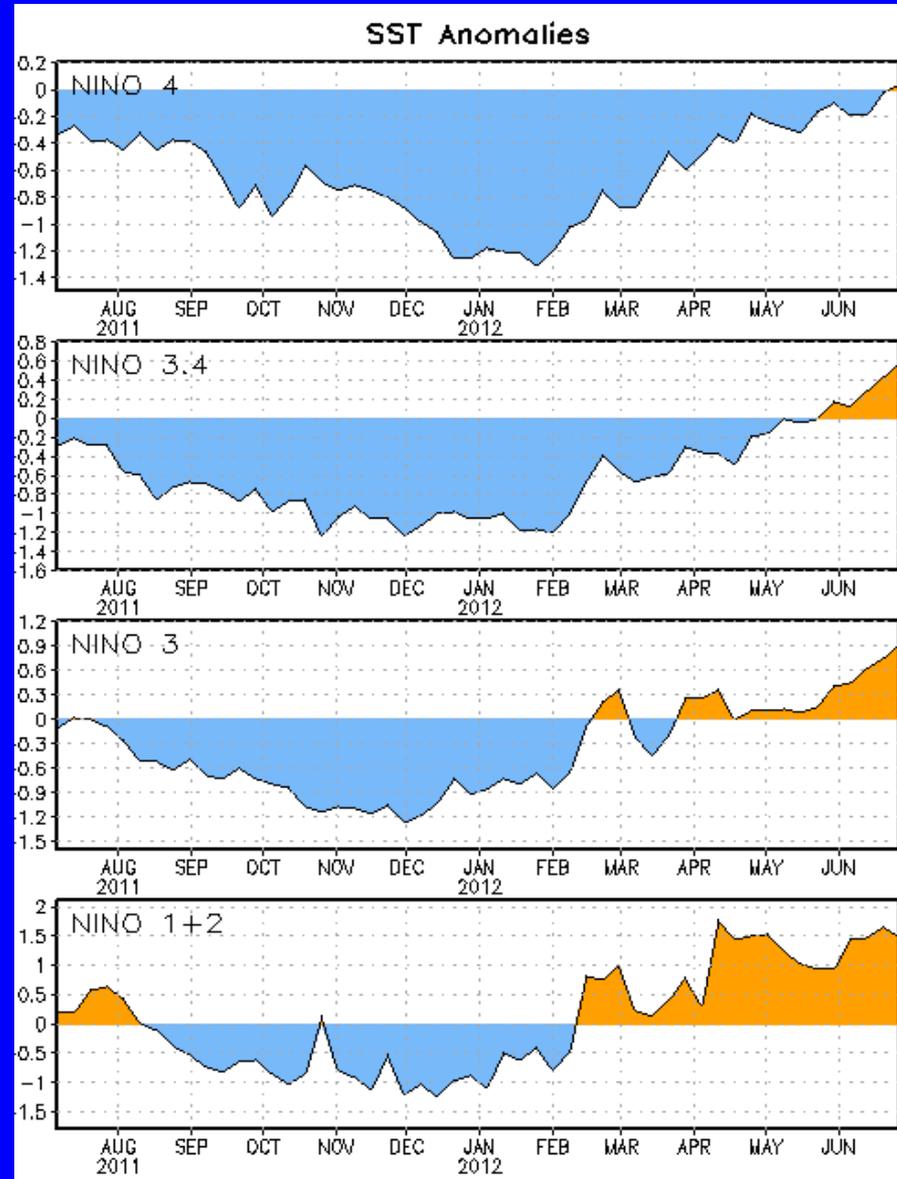
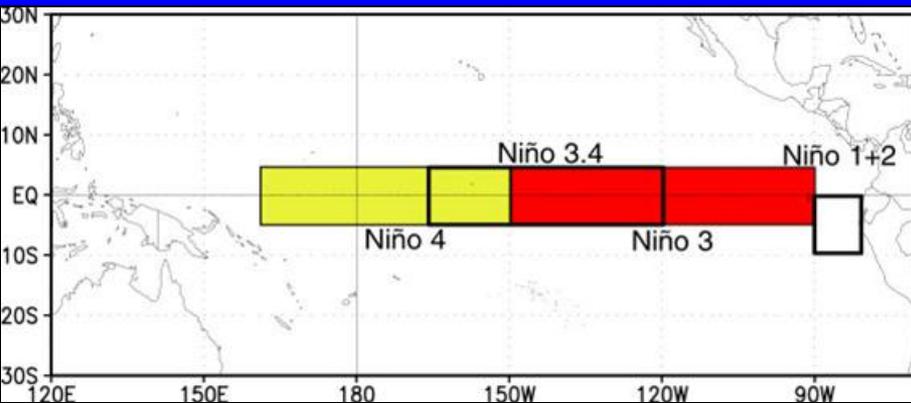


Niño Region SST Departures (°C)

Recent Evolution

The latest weekly SST departures are:

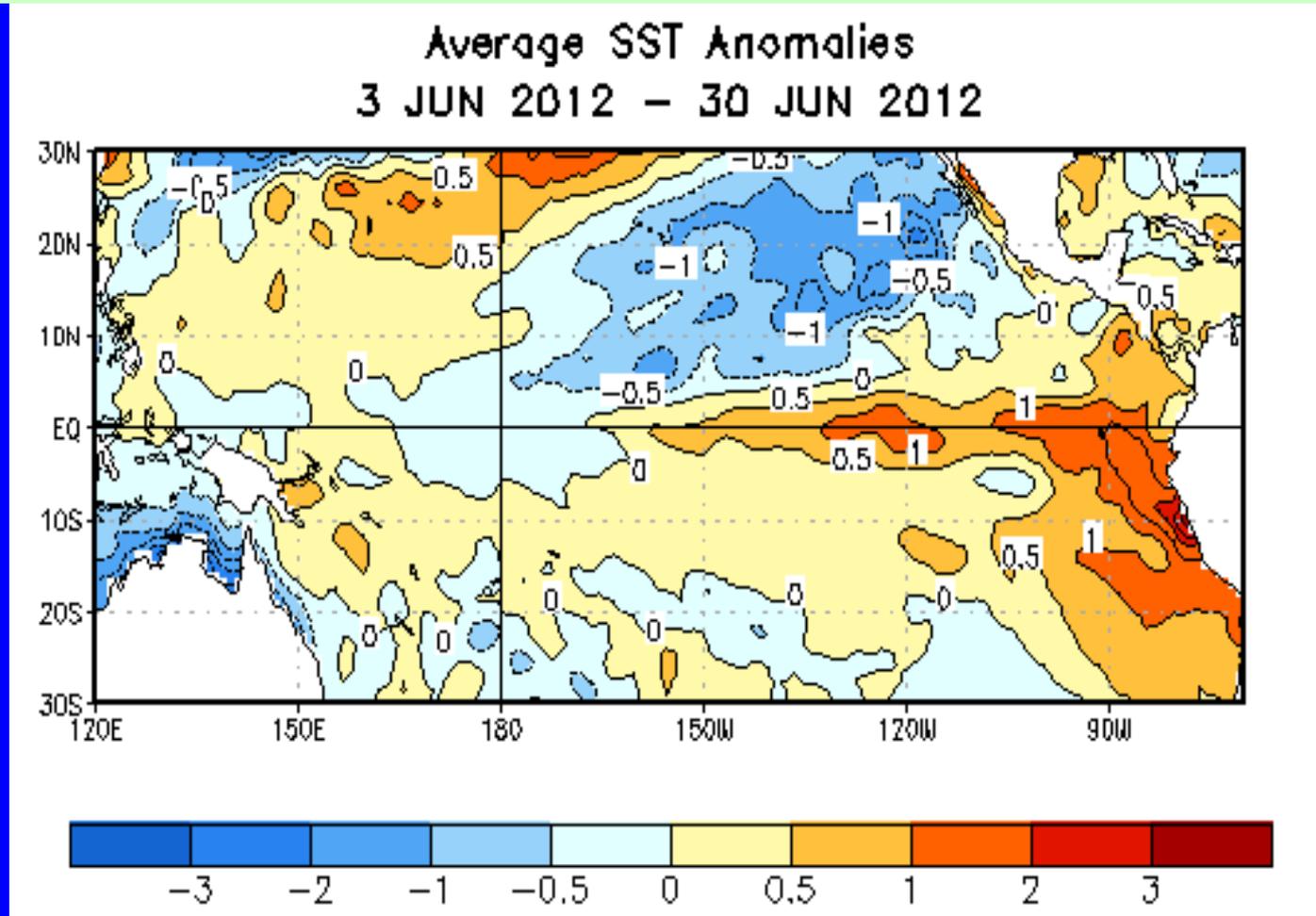
Niño 4 **0.0°C**
Niño 3.4 **0.6°C**
Niño 3 **0.9°C**
Niño 1+2 **1.5°C**





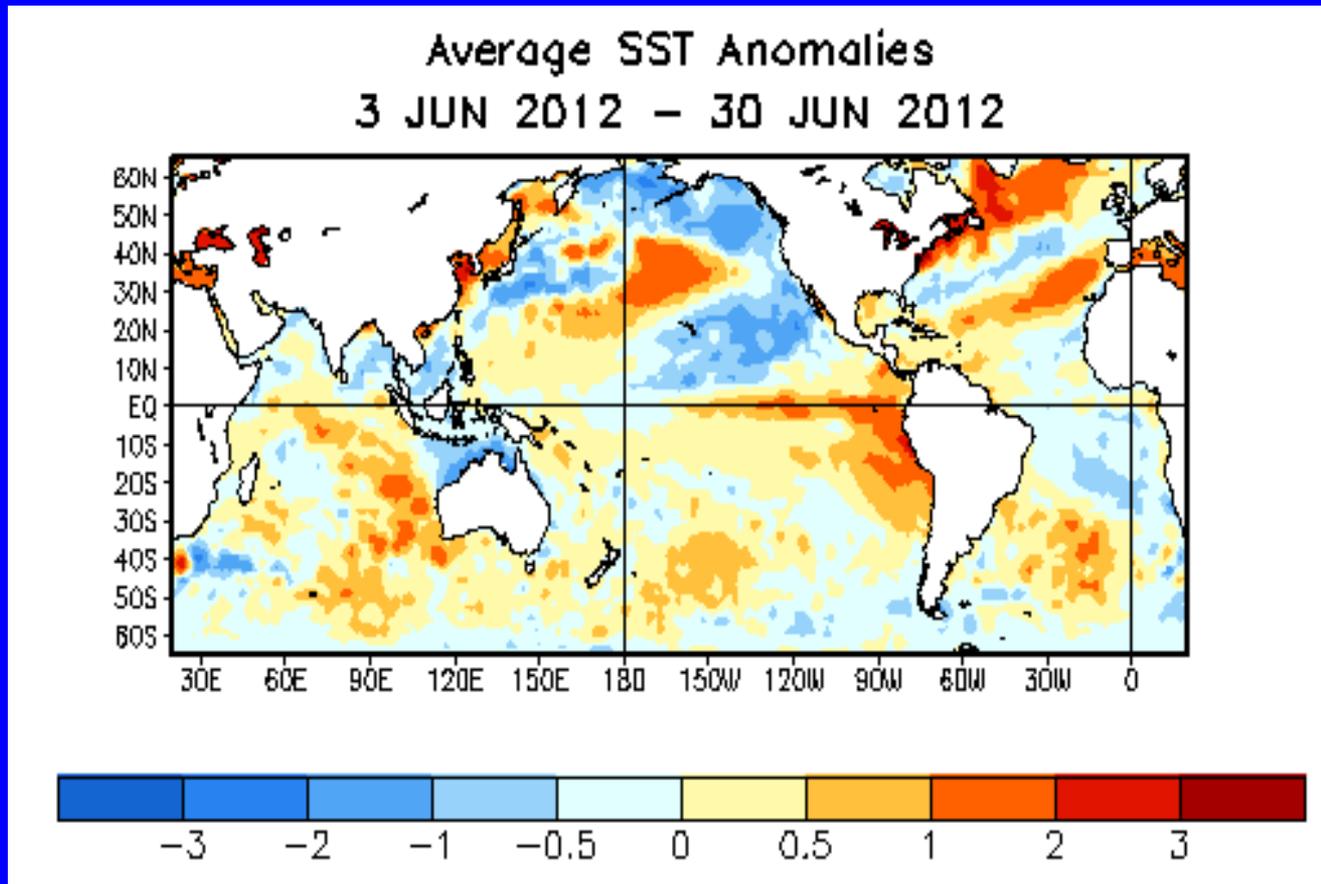
SST Departures ($^{\circ}\text{C}$) in the Tropical Pacific During the Last 4 Weeks

During the last 4-weeks, equatorial SSTs were more than 0.5°C above average east of $\sim 160^{\circ}\text{W}$.





Global SST Departures (°C)

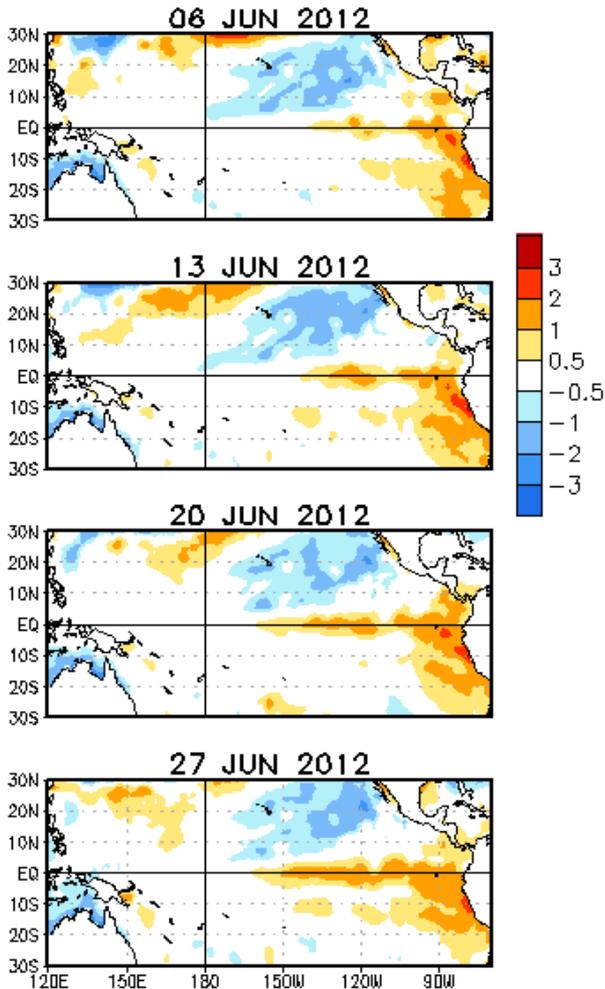


During the last four weeks, equatorial SSTs were above average in the eastern Pacific Ocean.



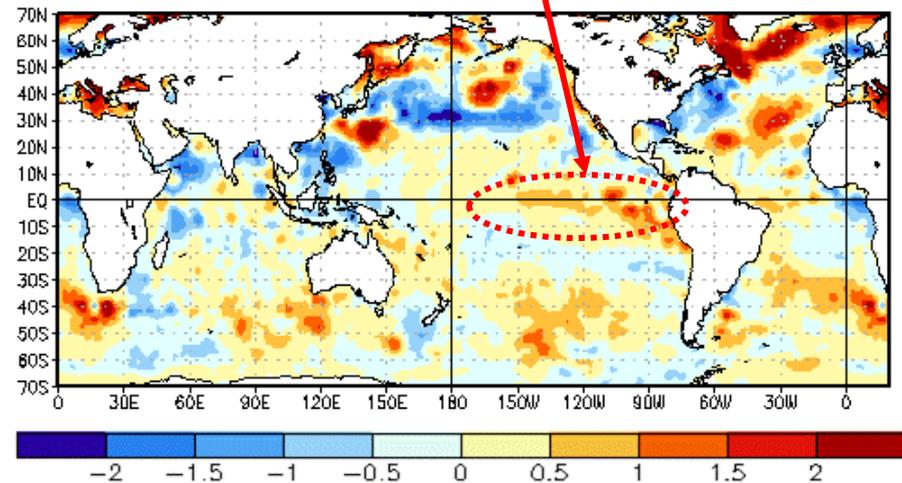
Weekly SST Departures (°C) for the Last Four Weeks

Weekly SST Anomalies (DEG C)



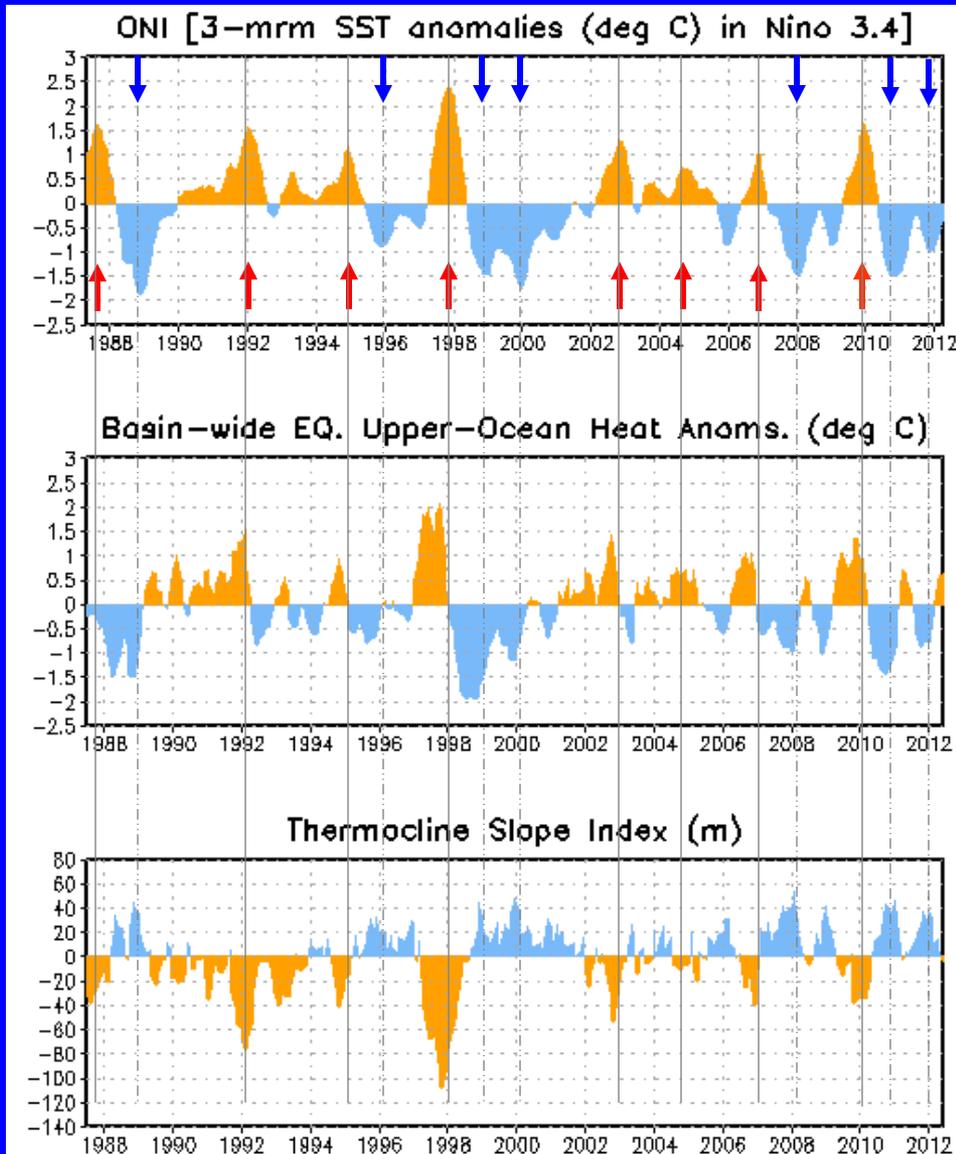
- During the last four weeks, above-average SSTs expanded westward in the eastern half of the equatorial Pacific.
- During the last 30 days, increasing SST anomalies are evident in the eastern Pacific.

Change in Weekly SST Anoma (°C)
27JUN2012 minus 30MAY2012





Upper-Ocean Conditions in the Eq. Pacific



Cold Episodes ↓
Warm Episodes ↑

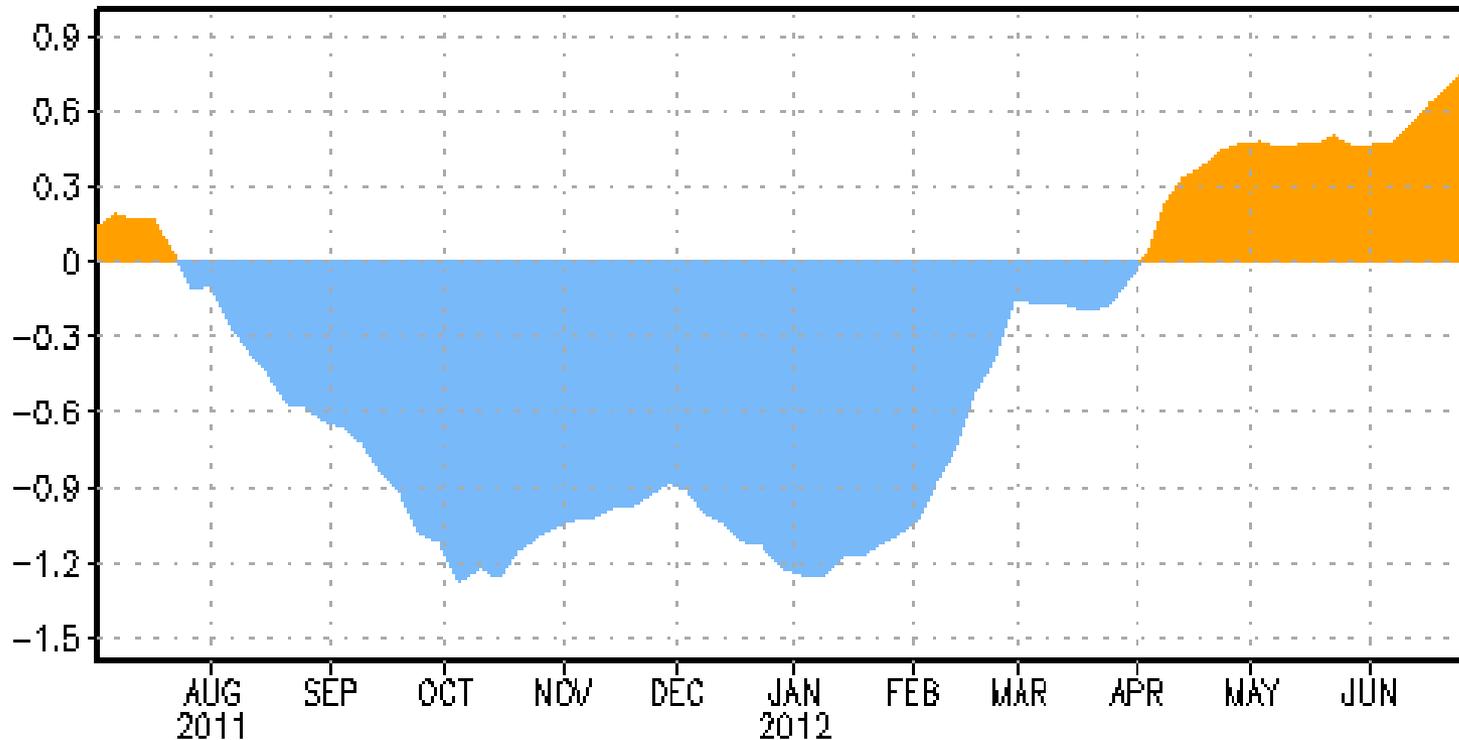
- The basin-wide equatorial upper ocean (0-300 m) heat content is **greatest** prior to and during the early stages of a Pacific **warm** (El Niño) episode (compare top 2 panels) and **least** prior to and during the early stages of a **cold** (La Niña) episode.
- The slope of the oceanic thermocline is least (greatest) during warm (cold) episodes.
- Recent values of the upper-ocean heat anomalies (slightly positive) and a weakening thermocline slope index reflect ENSO neutral conditions.

The monthly thermocline slope index represents the difference in anomalous depth of the 20°C isotherm between the western Pacific (160°E-150°W) and the eastern Pacific (90°-140°W).



Weekly Central & Eastern Pacific Upper-Ocean (0-300 m) Average Temperature Anomalies

EQ. Upper-Ocean Heat Anoms. (deg C) for 180-100W



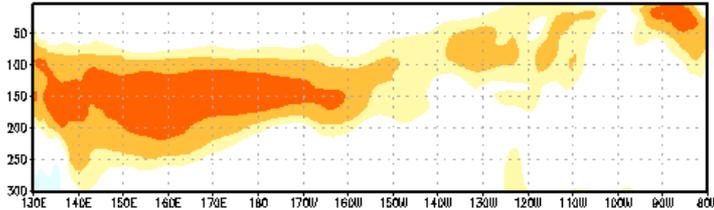
Negative subsurface temperature anomalies from late July 2011 through March 2012 reflected La Niña. Since April 2012, the anomalies have been positive with increases during April and June.



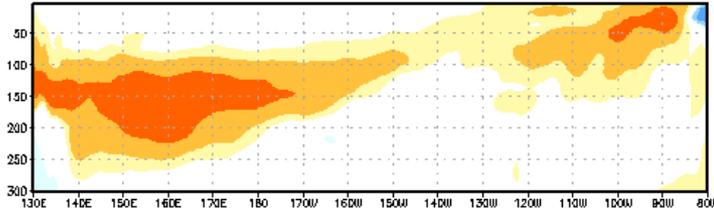
Sub-Surface Temperature Departures (°C) in the Equatorial Pacific

EQ. Subsurface Temperature Anomalies (deg C)

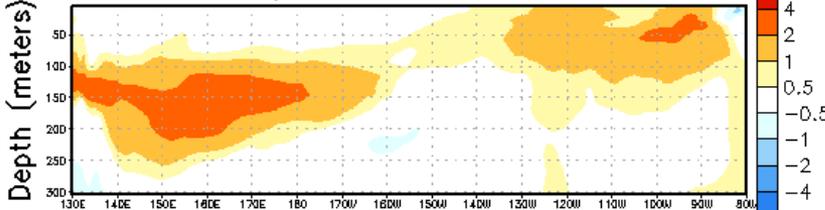
Three-pentad ave. centered on 08 MAY 2012



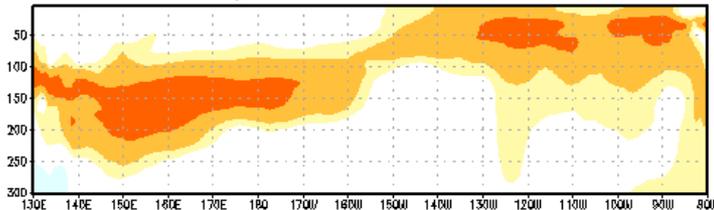
Three-pentad ave. centered on 23 MAY 2012



Three-pentad ave. centered on 07 JUN 2012



Three-pentad ave. centered on 22 JUN 2012



- During the last two months, positive subsurface temperature anomalies have become more prevalent, in part due to an eastward propagating downwelling Kelvin wave.

- During the recent period, positive subsurface temperature anomalies have increased in the eastern Pacific.

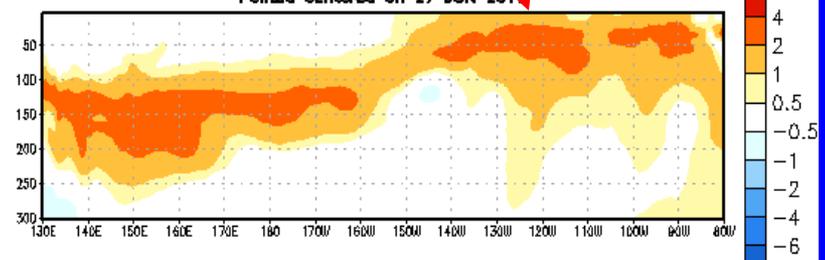
Time



Longitude

EQ. Subsurface Temperature Anomalies (deg C)

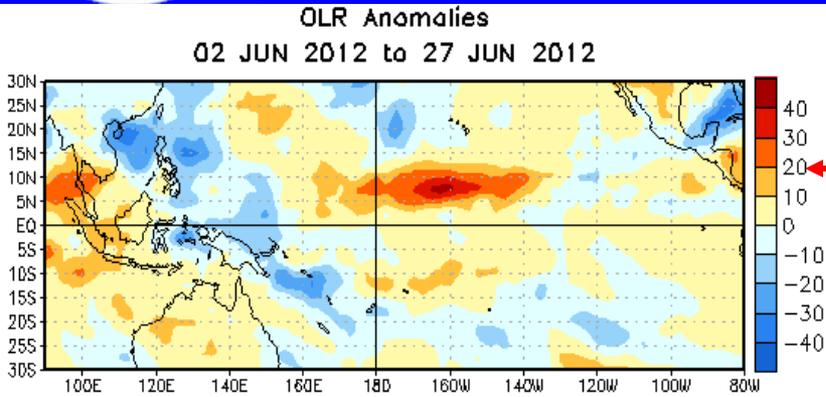
Pentad centered on 27 JUN 2012



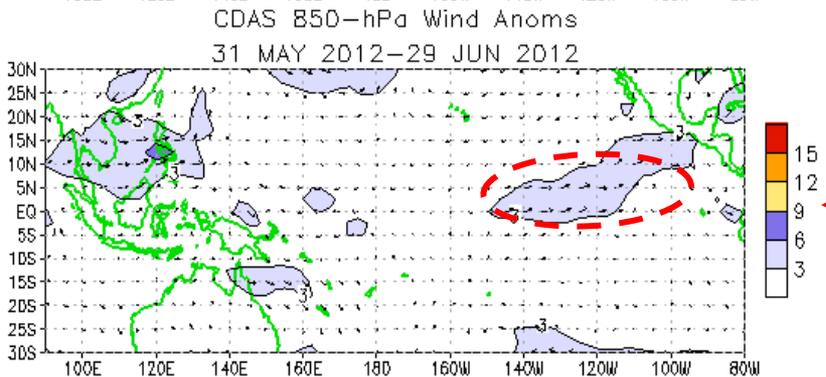
Most recent pentad analysis



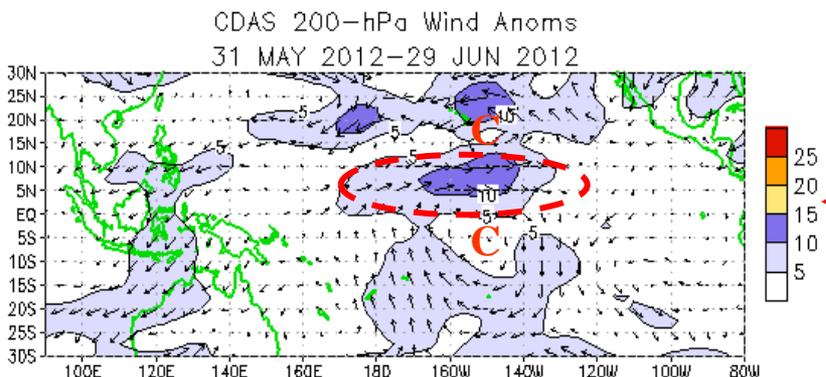
Tropical OLR and Wind Anomalies During the Last 30 Days



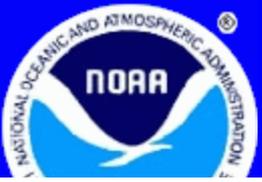
Negative OLR anomalies (enhanced convection and precipitation, blue shading) were observed over the Philippines, Philippine Sea, and Papua New Guinea. Positive OLR anomalies (suppressed convection and precipitation, red shading) were evident near the Date Line.



Weak low-level (850-hPa) westerly anomalies continued in the eastern Pacific.

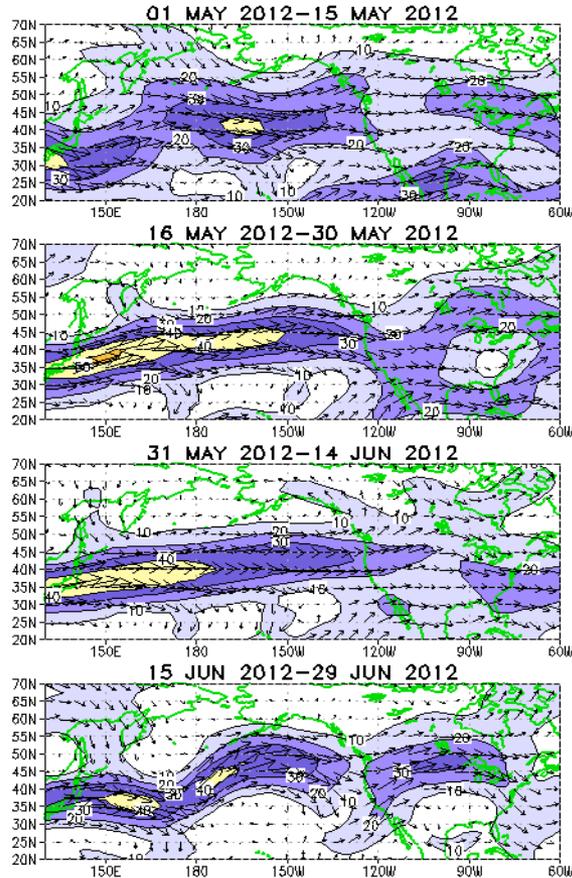


Upper-level (200-hPa) westerly anomalies were observed over the east-central tropical Pacific. Cyclonic circulation anomalies were present in the subtropics of both hemispheres.

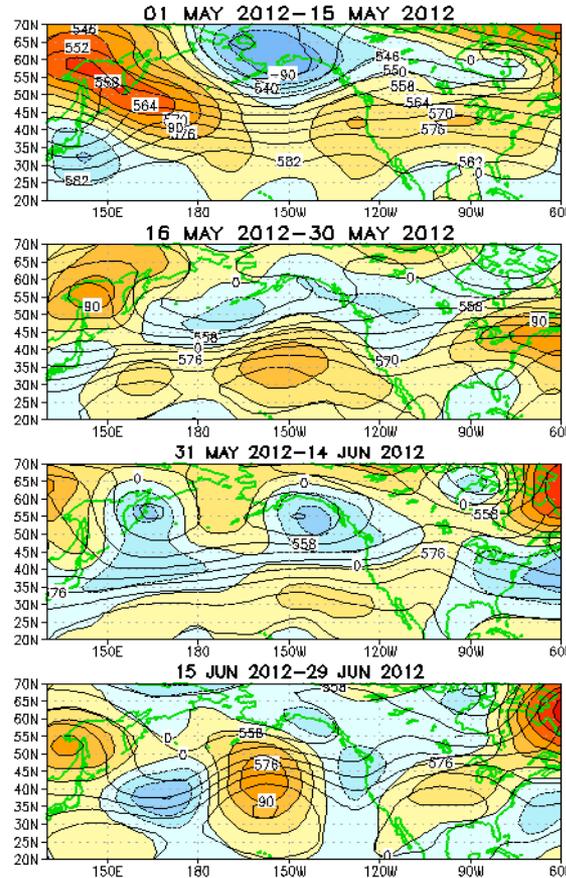


Atmospheric Circulation over the North Pacific & North America During the Last 60 Days

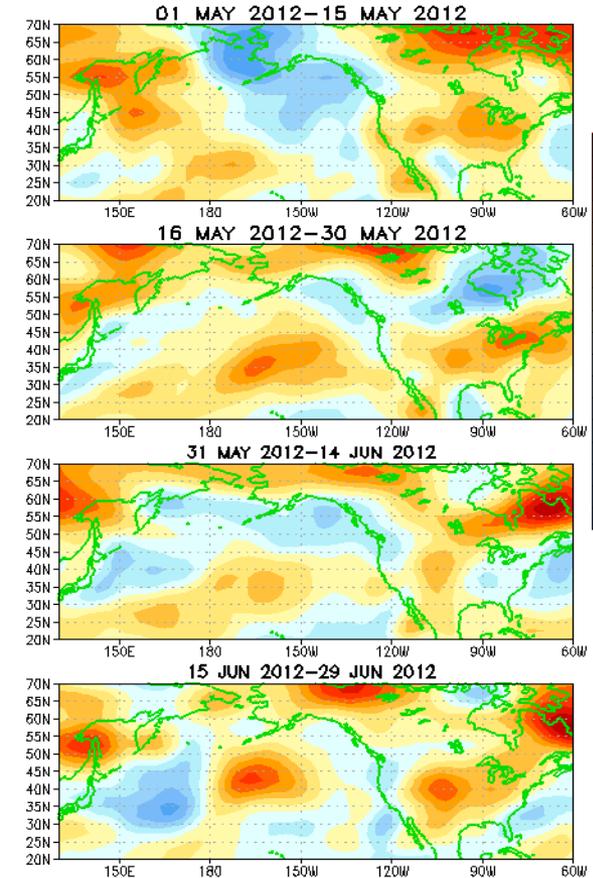
200-hPa Wind



500-hPa Height & Anoms.



925-hPa Temp. Anoms. (°C)

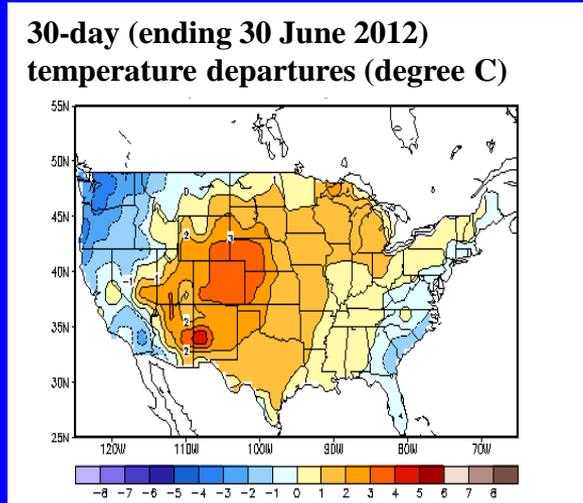
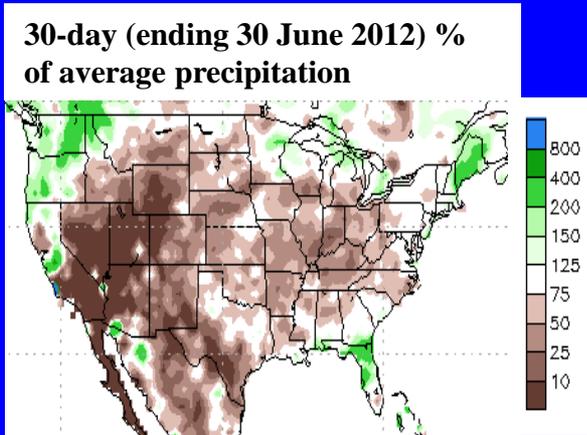


For most of the period (May through June), above-average 500-hPa heights and above-average temperatures occurred over the central and eastern U.S. , with below average heights and temperatures along the west coast.

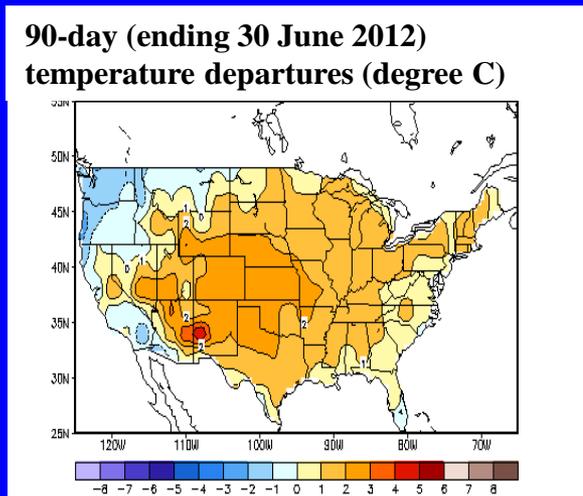
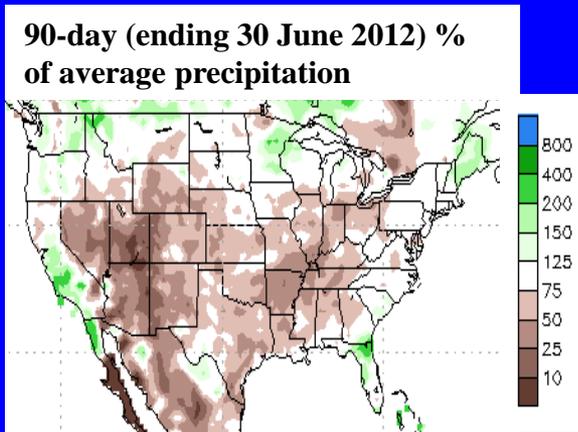


U.S. Temperature and Precipitation Departures During the Last 30 and 90 Days

Last 30 Days



Last 90 Days



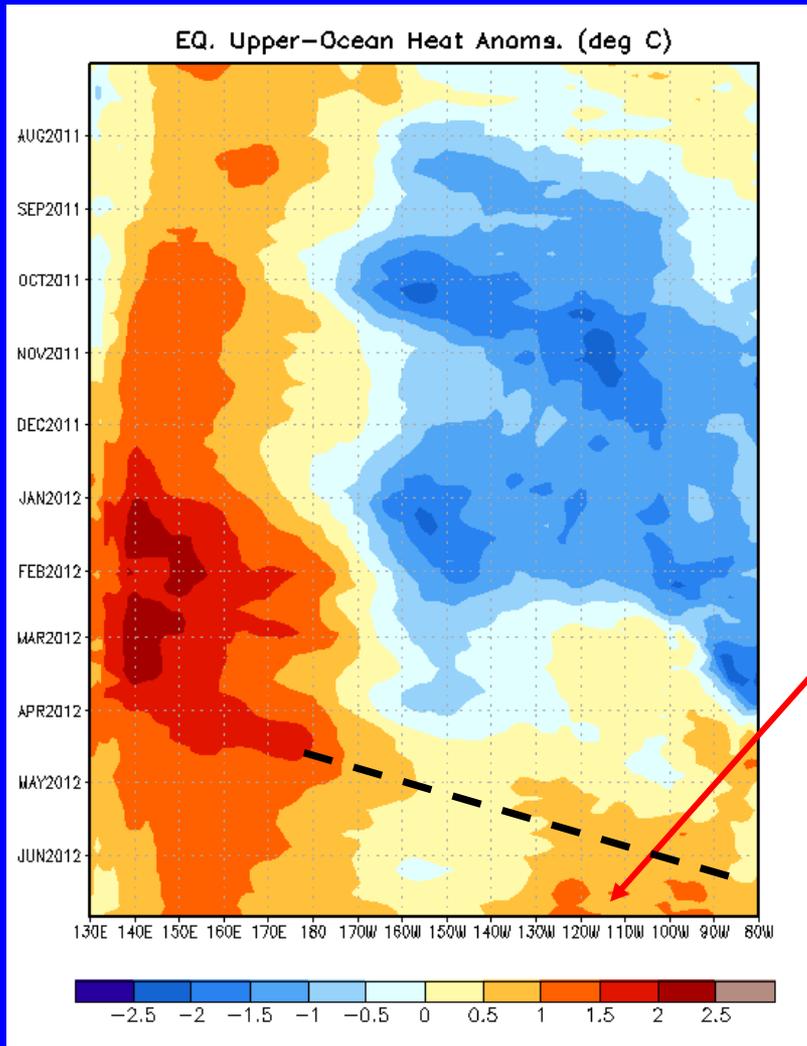


Intraseasonal Variability

- **Intraseasonal variability in the atmosphere (wind and pressure), which is often related to the Madden-Julian Oscillation (MJO), can significantly impact surface and subsurface conditions across the Pacific Ocean.**
- **Related to this activity**
 - **significant weakening of the low-level easterly winds usually initiates an eastward-propagating oceanic Kelvin wave.**



Weekly Heat Content Evolution in the Equatorial Pacific

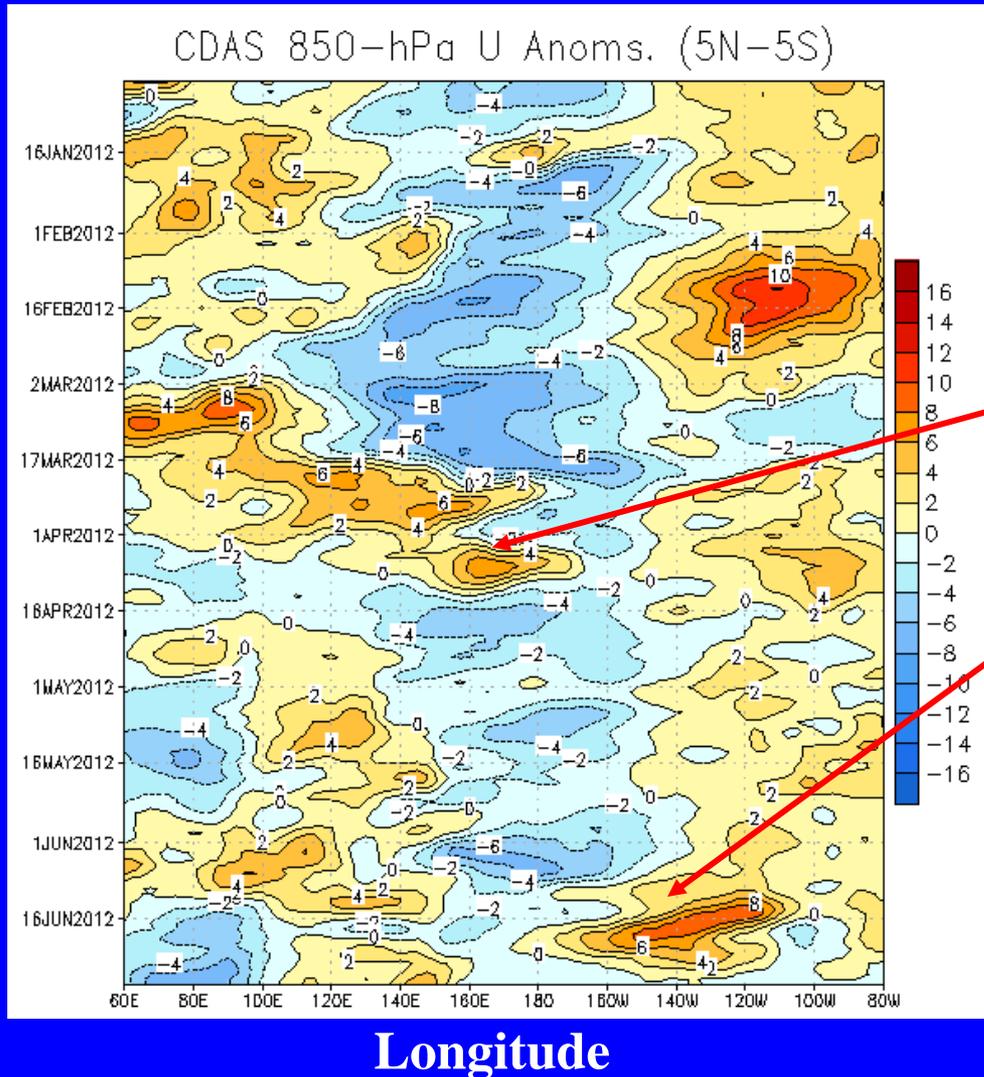


- From July 2011 – February 2012 heat content was below average in the central and eastern equatorial Pacific.
- From March- May 2012, heat content anomalies were positive across much of the equatorial Pacific, partly in association with a downwelling Kelvin wave.
- Recently, heat content anomalies have increased in the eastern Pacific.

• Oceanic Kelvin waves have alternating warm and cold phases. The warm phase is indicated by dashed lines. Down-welling and warming occur in the leading portion of a Kelvin wave, and up-welling and cooling occur in the trailing portion.



Low-level (850-hPa) Zonal (east-west) Wind Anomalies (m s^{-1})



Westerly wind anomalies (orange/red shading).

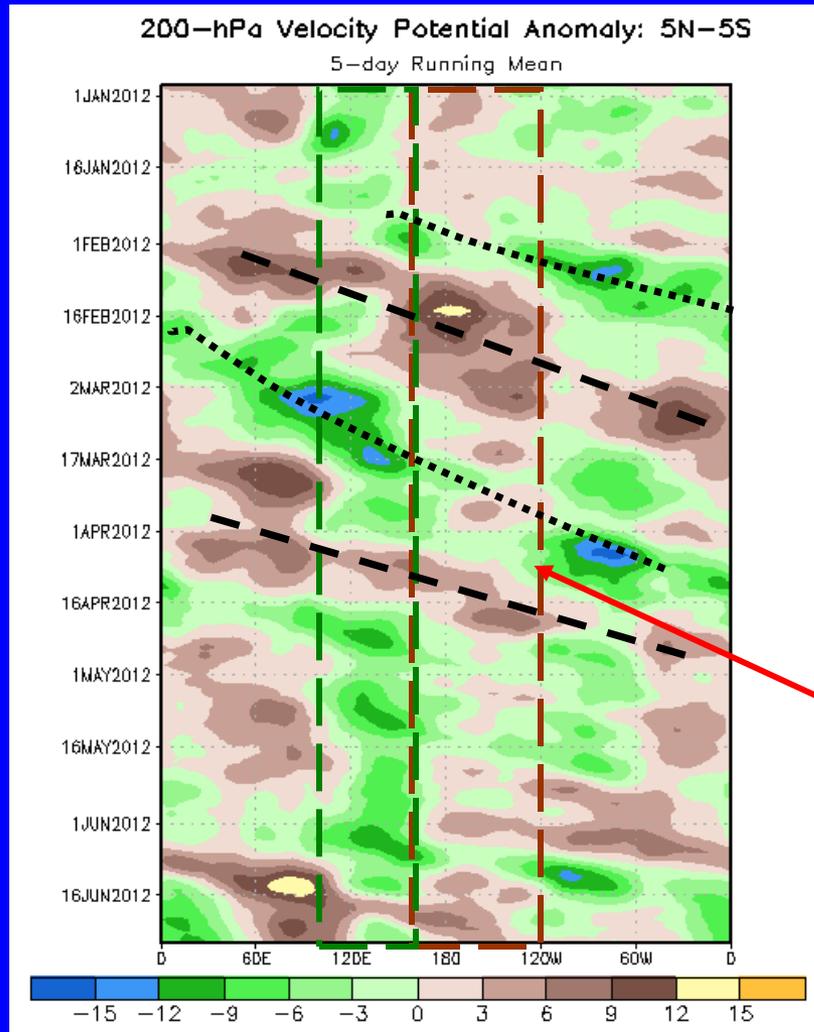
Easterly wind anomalies (blue shading).

During late March and early April, westerly anomalies were evident across the western equatorial Pacific, in part due to the MJO.

Recently, westerly wind anomalies have dominated much of the equatorial Pacific.



200-hPa Velocity Potential Anomalies (5°N-5°S)



Positive anomalies (brown shading) indicate unfavorable conditions for precipitation.

Negative anomalies (green shading) indicate favorable conditions for precipitation.

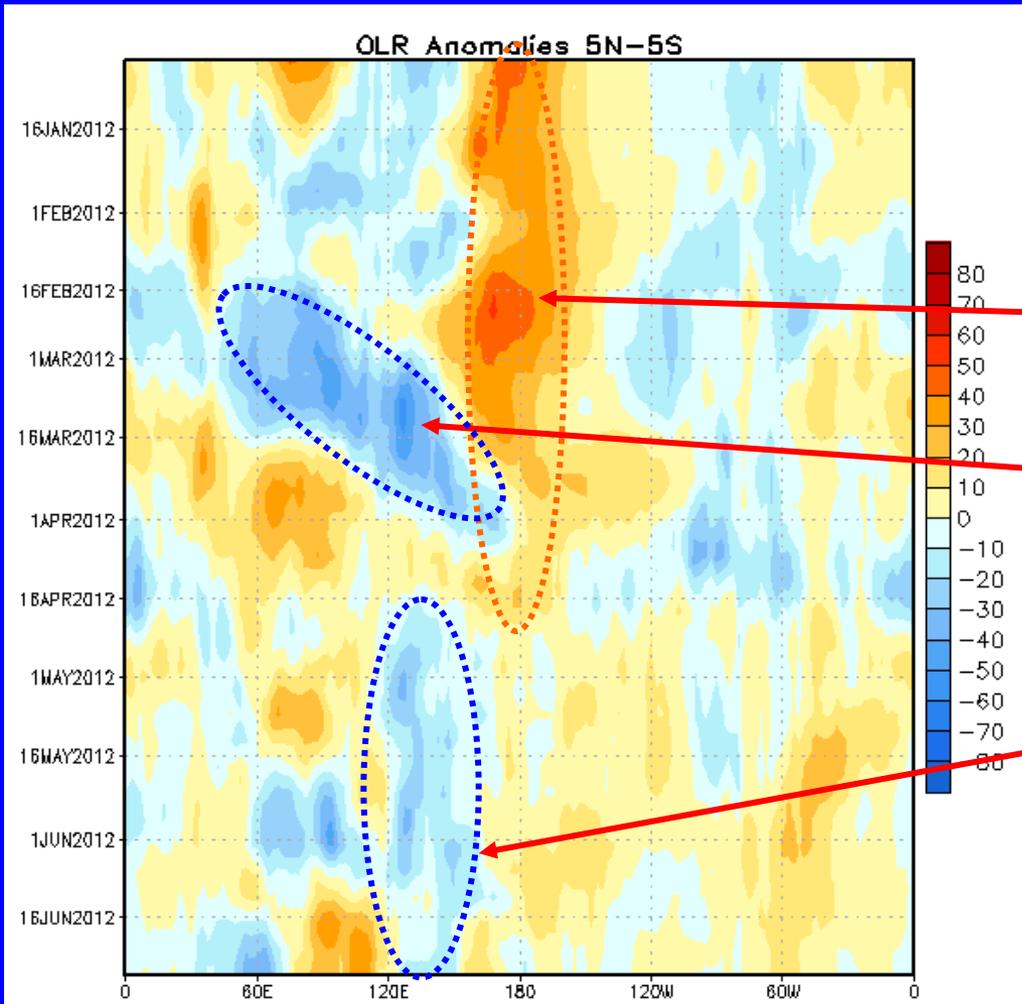
Through the period, a quasi-persistent pattern of upper-level convergence anomalies (brown) was evident over the central Pacific, while anomalous upper-level divergence (green) generally prevailed over the Maritime Continent.

The MJO was active during October through December 2011 and again during February through mid April 2012.



Outgoing Longwave Radiation (OLR) Anomalies

Time



Longitude

Drier-than-average conditions (orange/red shading)

Wetter-than-average conditions (blue shading)

From April 2010 – April 2012, negative OLR anomalies were observed near the Maritime Continent and positive OLR anomalies prevailed over the western and central Pacific.

During February through March, eastward propagation of negative OLR anomalies is evident.

Since mid-April, negative OLR anomalies have persisted near the western Pacific and eastern Maritime Continent.



Oceanic Niño Index (ONI)

- The ONI is based on SST departures from average in the Niño 3.4 region, and is a principal measure for monitoring, assessing, and predicting ENSO.
- Defined as the three-month running-mean SST departures in the Niño 3.4 region. Departures are based on a set of improved homogeneous historical SST analyses (Extended Reconstructed SST – **ERSST.v3b**). The SST reconstruction methodology is described in Smith et al., 2008, *J. Climate*, vol. 21, 2283-2296.)
- Used to place current events into a historical perspective
- NOAA's operational definitions of El Niño and La Niña are keyed to the ONI index.



NOAA Operational Definitions for El Niño and La Niña

El Niño: characterized by a *positive* ONI greater than or equal to $+0.5^{\circ}\text{C}$.

La Niña: characterized by a *negative* ONI less than or equal to -0.5°C .

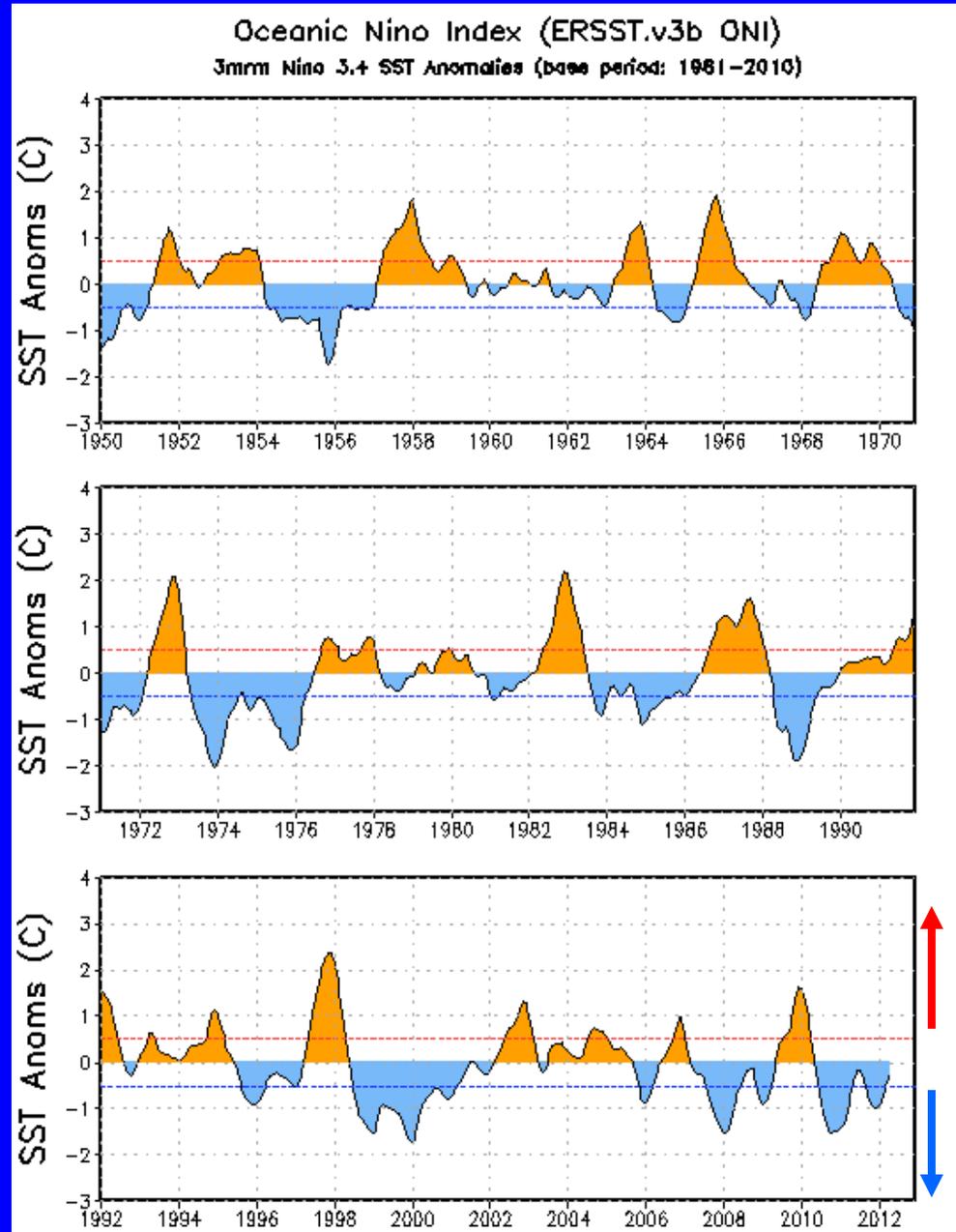
By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed $\pm 0.5^{\circ}\text{C}$ along with consistent atmospheric features. These anomalies must also be forecasted to persist for 3 consecutive months.



ONI (°C): Evolution since 1950

The most recent ONI value (March – May 2012) is **-0.3°C**.



El Niño
neutral
La Niña



Historical El Niño and La Niña Episodes

Based on the ONI computed using ERSST.v3b

| <u>El Niño</u> | <u>Highest ONI Value</u> | <u>La Niña</u> | <u>Lowest ONI Value</u> |
|------------------------|--------------------------|------------------------|-------------------------|
| JJA 1951 – DJF 1951/52 | 1.2 | ASO 1949 – JAS 1950 | -1.4 |
| DJF 1952/53 – JFM 1954 | 0.8 | SON 1950 – JFM 1951 | -0.8 |
| MAM 1957 – JJA 1958 | 1.8 | AMJ 1954 – NDJ 1956/57 | -1.7 |
| OND 1958 – FMA 1959 | 0.6 | AMJ 1964 – DJF 1964/65 | -0.8 |
| MJJ 1963 – JFM 1964 | 1.4 | JJA 1970 – DJF 1971/72 | -1.3 |
| AMJ 1965 – MAM 1966 | 1.9 | AMJ 1973 – JJA 1974 | -2.0 |
| JAS 1968 – DJF 1969/70 | 1.1 | SON 1974 – MAM 1976 | -1.7 |
| AMJ 1972 – FMA 1973 | 2.1 | ASO 1983 – DJF 1983/84 | -0.9 |
| ASO 1976 - JFM 1977 | 0.8 | SON 1984 – ASO 1985 | -1.1 |
| ASO 1977 – JFM 1978 | 0.8 | AMJ 1988 – AMJ 1989 | -1.9 |
| AMJ 1982 – MJJ 1983 | 2.2 | ASO 1995 – FMA 1996 | -0.9 |
| JAS 1986 – JFM 1988 | 1.6 | JJA 1998 – FMA 2001 | -1.7 |
| AMJ 1991 – MJJ 1992 | 1.6 | OND 2005 – FMA 2006 | -0.9 |
| ASO 1994 – FMA 1995 | 1.2 | JAS 2007 – MJJ 2008 | -1.5 |
| AMJ 1997 – MAM 1998 | 2.4 | JJA 2010 – MAM 2011 | -1.5 |
| AMJ 2002 – JFM 2003 | 1.3 | ASO 2011 – FMA 2012 | -1.0 |
| JJA 2004 – DJF 2004/05 | 0.7 | | |
| ASO 2006 – DJF 2006/07 | 1.0 | | |
| JJA 2009 – MAM 2010 | 1.6 | | |

NOTE (Mar. 2012):

The historical values of the ONI have slightly changed due to an update in the climatology. Please click here for more details on the methodology:

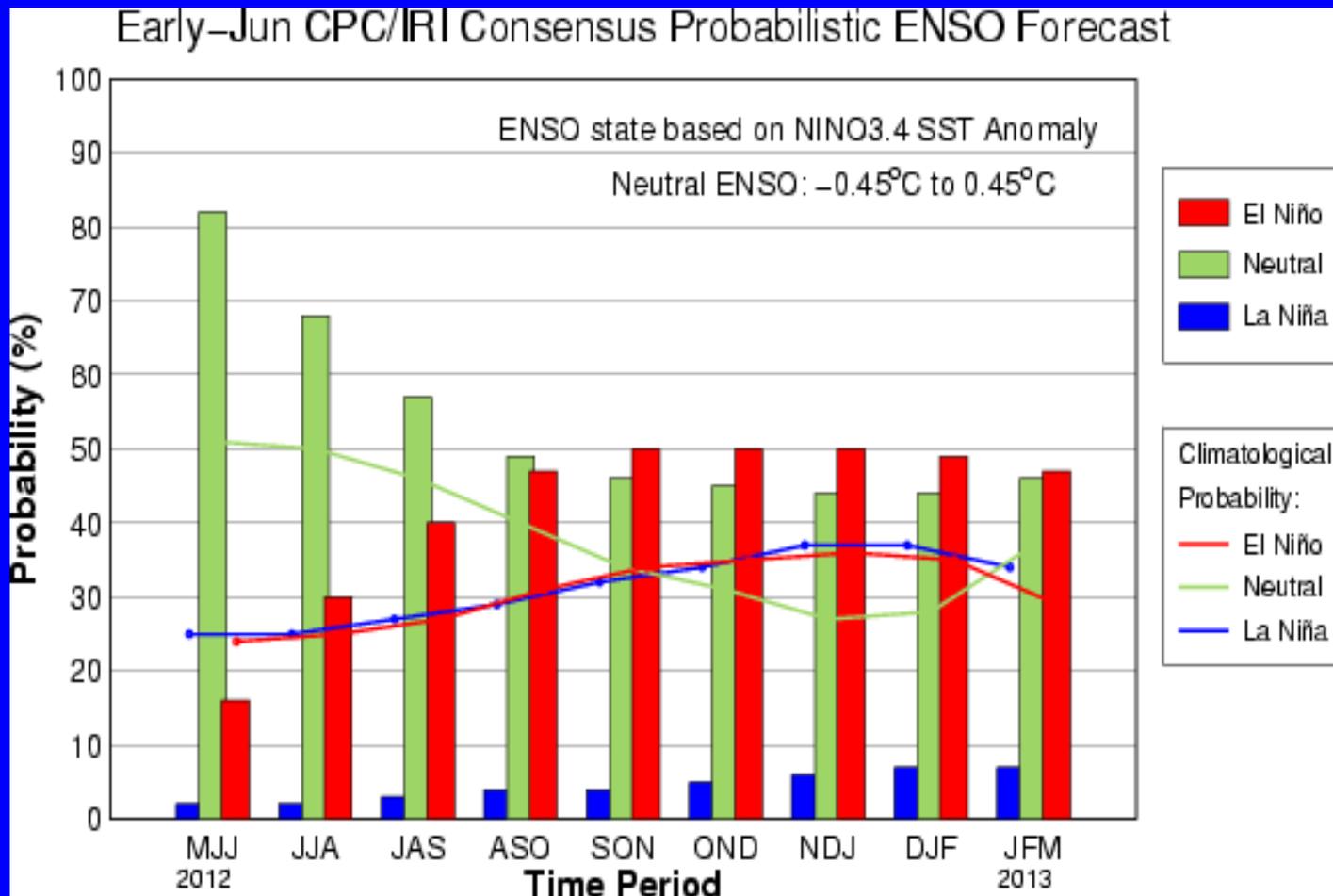
[Historical ONI Values](#)



Official Probabilistic ENSO Outlook

(updated 7 June 2012)

ENSO-neutral is favored through the Northern Hemisphere summer, with approximately equal chances of neutral or El Niño conditions during the fall and winter.





Pacific Niño 3.4 SST Outlook

- Nearly all of the dynamical models predict a transition from ENSO-neutral conditions (Niño-3.4 SST anomalies between -0.5°C and $+0.5^{\circ}\text{C}$) to El Niño during the Northern Hemisphere summer/fall, with El Niño continuing through the remainder of the year.
- The average dynamical model forecast is warmer than the statistical models during the second half of 2012/early 2013.

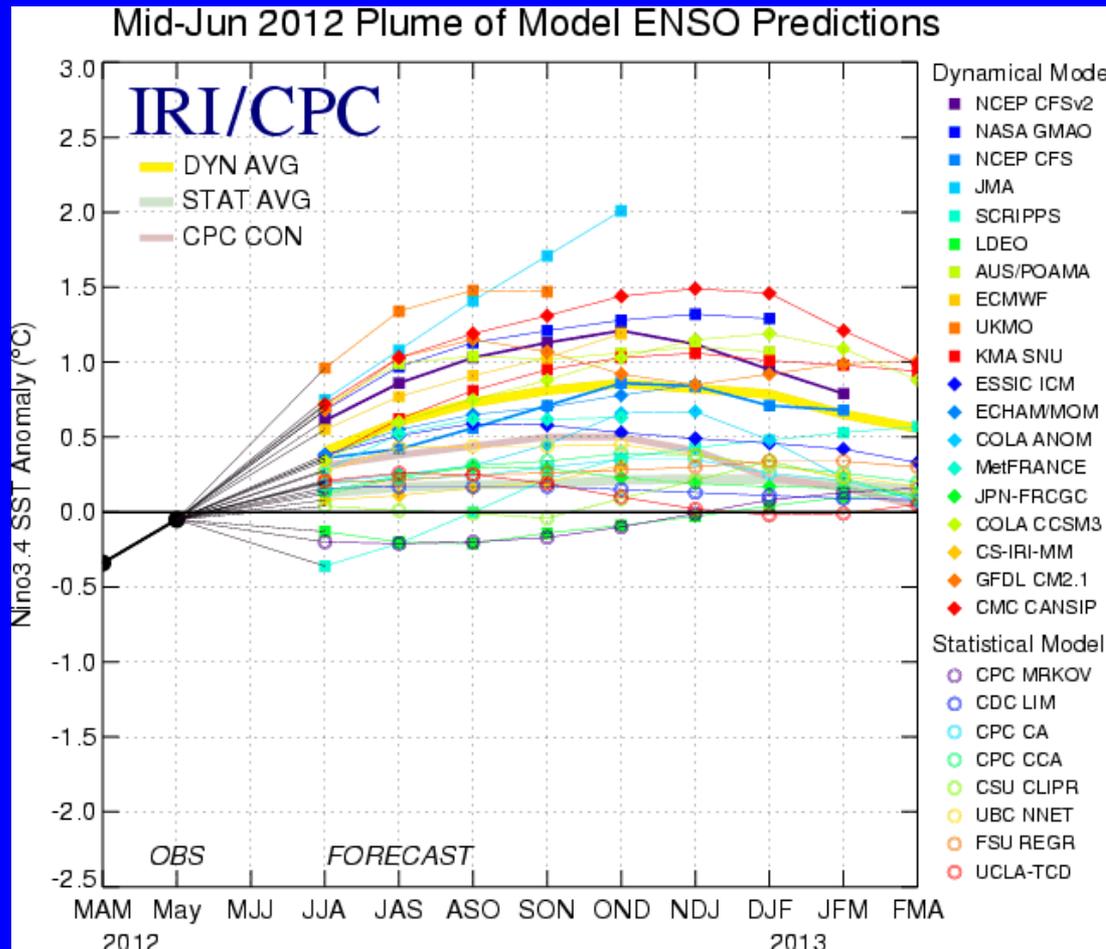
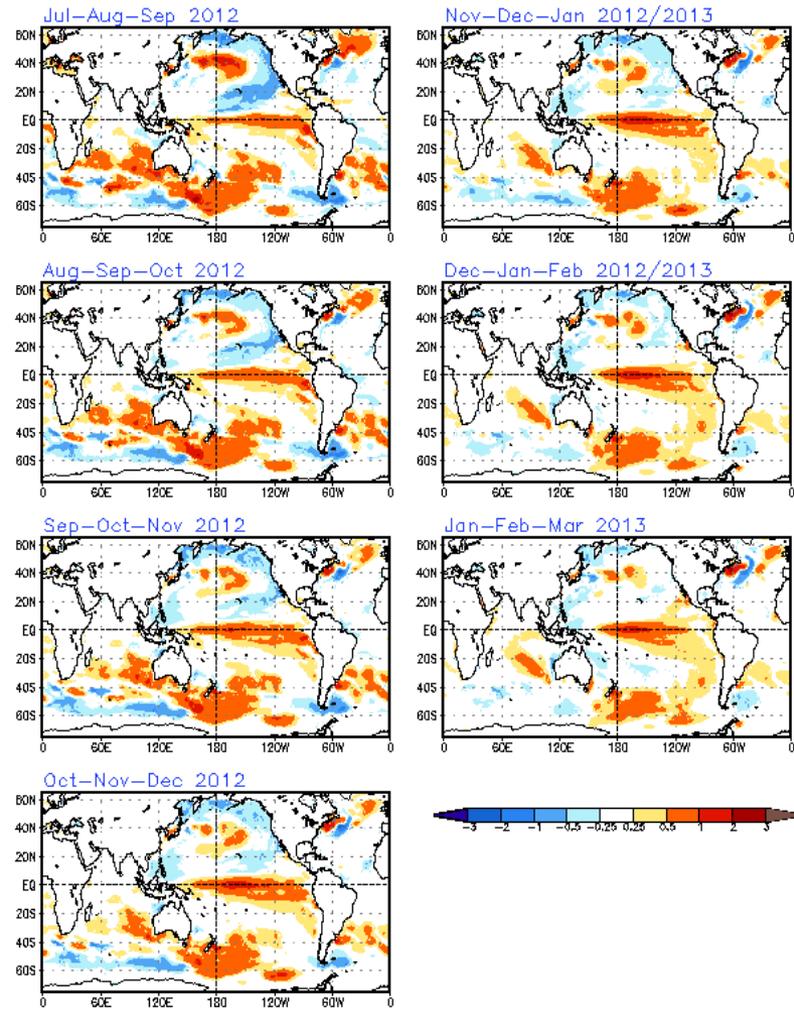


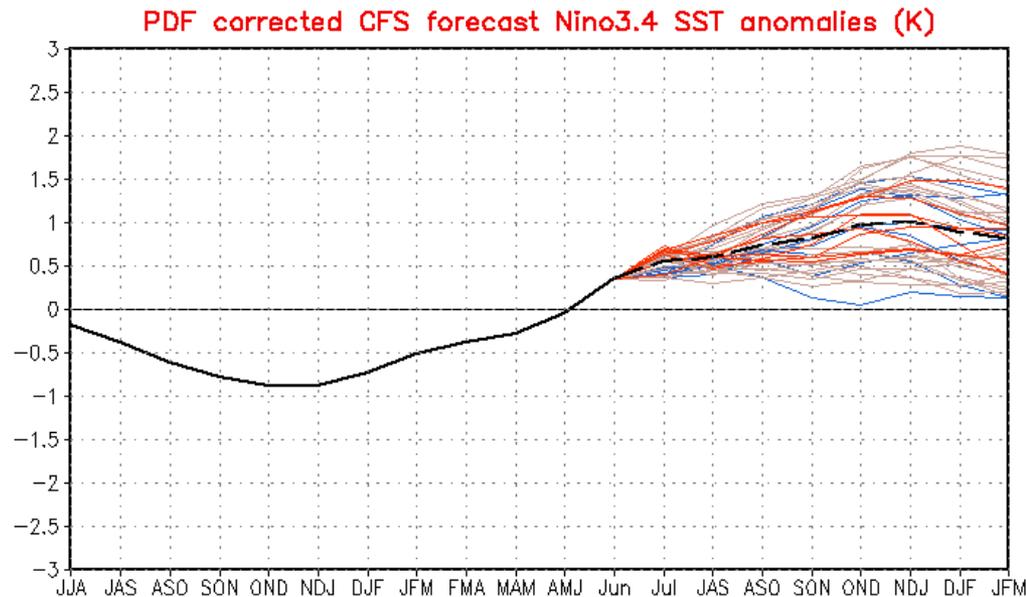
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 15 June 2012).



SST Outlook: NCEP CFS.v1 Forecast Issued 1 July 2012



The CFS.v1 ensemble mean (black dashed line) predicts El Niño to develop by the end of July 2012.



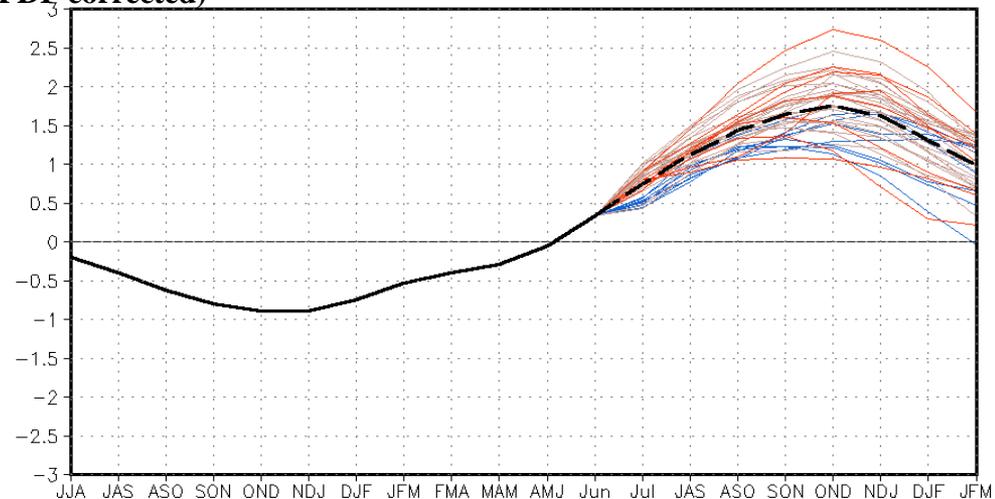
Please note that CFS.v1 will be discontinued in October 2012.



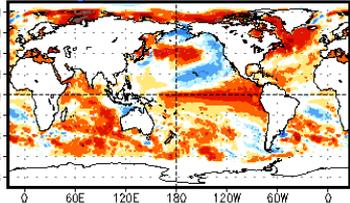
SST Outlook: NCEP CFS.v2 Forecast Issued 2 July 2012

The CFS.v2 ensemble mean (black dashed line) predicts El Niño conditions to develop by the end of July 2012.

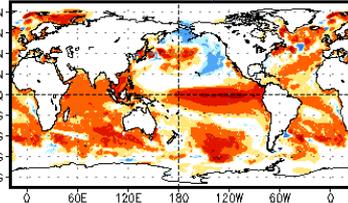
(not PDF corrected) CFSv2 forecast Nino3.4 SST anomalies (K)



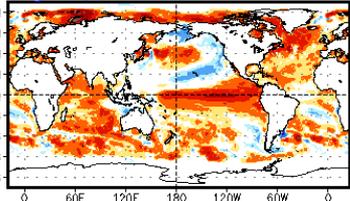
Jul-Aug-Sep 2012



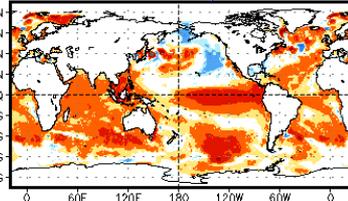
Nov-Dec-Jan 2012/2013



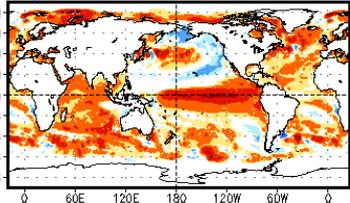
Aug-Sep-Oct 2012



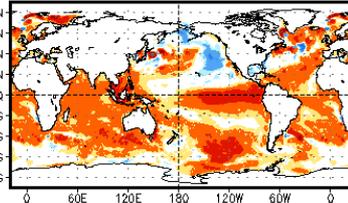
Dec-Jan-Feb 2012/2013



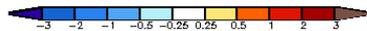
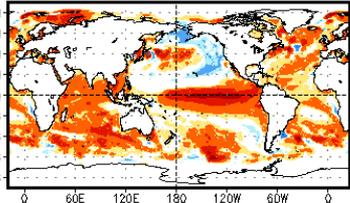
Sep-Oct-Nov 2012



Jan-Feb-Mar 2013



Oct-Nov-Dec 2012

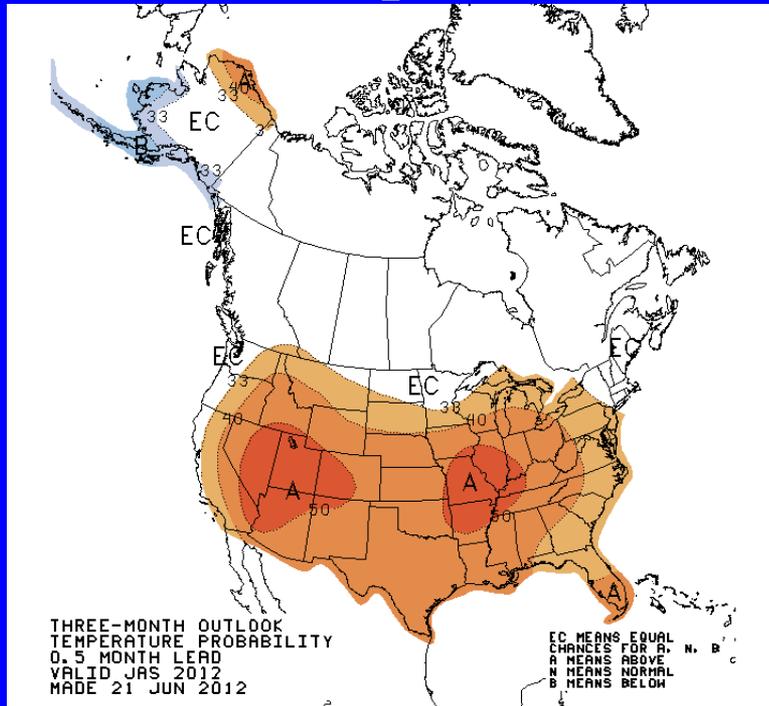


(Model bias correction base period: 1999-2010; Climatology base period: 1982-2010)

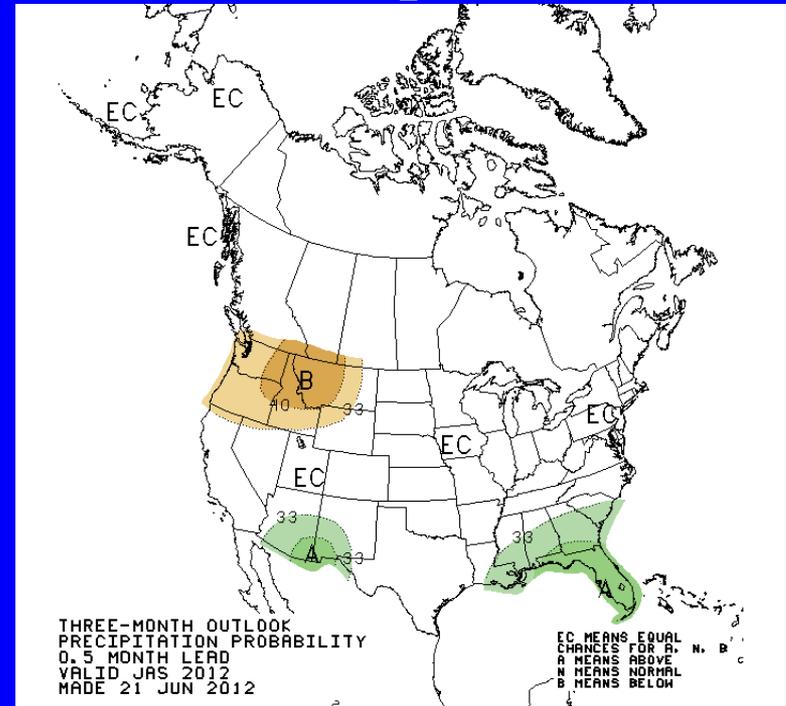


U. S. Seasonal Outlooks July – September 2012

Temperature



Precipitation



The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.



Summary

- **ENSO-neutral conditions continue.***
- **Equatorial sea surface temperatures (SST) are increasingly above average in the eastern Pacific Ocean.**
- **The atmospheric circulation over the tropical Pacific reflects cool-to-neutral ENSO conditions.**
- **There is a 50% chance that El Niño conditions will develop during the second half of 2012.***

* Note: These statements are updated once a month in association with the ENSO Diagnostics Discussion:
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory